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Weather Lore in the Light of Science

THE correspondence columns of the *Meteorological Magazine* testify to the perennial interest in weather proverbs. Many must have felt that an authoritative discussion of such proverbs and their application to local weather forecasting was wanted. Professor Humphreys, who writes with enthusiasm on meteorological physics and who commands an easy style, is in many ways well qualified for the task.

The first part of his book *Weather Proverbs and Paradoxes* is based on an article published in 1911 in the *Popular Science Monthly*, for May, and is devoted to proverbs.

The weather proverb which is perhaps the most frequently quoted in this country is

> "Red sky at night is the shepherd's delight;
> Red in the morning is the shepherd's warning."

Professor Humphreys points out that this proverb has many variations, and that it is to be found not only in Shakespeare but in the Bible. The words of Jesus, as quoted in the Gospel according to St. Matthew (xvi. 2), are: "When it is evening ye say fair weather, for the heaven is red. And in the morning foul weather to-day, for the heaven is red and lowring." The authorised translation interpolates "it will be" in each half of the saying, but it gains in force by the omission of those words. Professor Humphreys entirely ignores the qualification "and lowring." This is highly significant, for in his discussion it is implied that the red sky to which reference is made is free

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from cloud. He dwells on the contrast between gray cloudy skies and red cloudless skies. This seems to be a fundamental mistake. The red sky which attracts attention is usually more or less covered with clouds at moderate heights and it is the illumination of the under side of such clouds that calls for our admiration. It is certainly true that the appropriate cloud distribution often occurs in this country in the evening in fine settled weather. It may be that at sunrise it is more characteristic of the lowring heaven and the coming storm. No one seems to have made the regular observations which would establish the proposition statistically. Professor Humphreys looks at the question from a different standpoint. He writes: "A red morning sky means . . . . that the atmosphere is rather humid, else the clear sky would have a short wave-length color, such as yellow or green; that, as the sky is not gray, there are no dew, or water, droplets on the dust particles of the lower air; that therefore this dust has been protected from excessive loss of heat by radiation; and, from this in turn, that the upper air contains much moisture, the condition that holds radiation losses down to a minimum. That is, a red morning sky implies that the whole atmosphere, up to considerable elevations, is humid, and rain, therefore probable, later in the day." This statement is hard to follow. It might even be characterised as special pleading. Is the absence of "dew droplets on the dust particles of the lower air," *i.e.*, mist, in itself an indication that there is an excess of moisture aloft? The fact is that the whole question will have to be threshed out on scientific lines before it will be profitable to set out any explanation in a popular form.

The same absence of the statistics which would show how frequently the forecast embodied in the proverb is successful will be found in every instance. This is the more to be regretted as the appropriate information with regard to the weather that follows such phenomena as halos could be worked up without much labour.

Professor Humphreys is not content to take proverbs as he finds them, he invents new ones (a pedant would say new epigrams), such as

> Glimpse you e'er the green ray
> Count the morrow a fine day.

> A summer fog for fair,
> A winter fog for rain;
> A fact most everywhere
> In valley and on plain.

Presumably "most everywhere"* does not include London.

* "Most" for "almost" seems to be accepted in American scientific literature, without even an apologetic apostrophe.

Our winter fogs cannot be regarded as prognostics of rain. With reference to dew, Humphreys chants:

When the morn is dry
The rain is nigh;
When the morn is wet
No rain you get.

The second part of the book is based on an article on meteorological paradoxes in *The Journal of the Washington Academy of Science*, 1920. The paradoxes are arresting.

Air pushed north blows east.
Rain dries the air.
To warm air cool it.
The coldest air covers the warmest earth.
The sun sets after it is down.

The greatest paradox of all and the most controversial is

The hotter the sun, the colder the earth.

The explanations of all the paradoxes are set out very lucidly, and if the book does not fulfil the expectation of the publishers and make every reader weather wise, it should add to the number who wish to carry further their studies in meteorology.

Aitken's Researches

THE Collected Papers of Dr. John Aitken form a valuable and interesting volume, containing an immense amount of information upon a variety of subjects—rigidity, glacier motion, the colour of the sea, ocean circulation, freezing, boiling, condensation, dew, fog, sunsets, atmospheric dust, and in fact almost every physical phenomenon in conspicuous evidence in Nature. The collection includes the famous papers on dust, fogs, clouds and dew, and there is an introductory sketch of the life and scientific work of the author by the late Dr. Cargill G. Knott, F.R.S., to whom the selection of the included papers and the preparation of the volume were entrusted by the Council of the Royal Society of Edinburgh. Aitken's work was carried out primarily as a hobby, undertaken because the handicap of ill-health rendered him unable to follow the chosen profession of engineering.

Since the constituent papers were originally independent communications, generally to the Royal Society of Edinburgh, there is little pretence of continuity in the finished collection, although many of the papers deal with closely allied subjects. It is, however, manifest throughout that Dr. Aitken was a scientist of the first order, a very capable and ingenious experimentalist. He possessed remarkable ability in interpreting the processes and phenomena of Nature, devising experiments to illustrate them, and presenting his explanations in such a manner that they appeared incontrovertible.

There is, however, a suspicion that on encountering fresh problems, preferably difficulties over which others had stumbled, he was apt to form rather hasty conclusions, and it would appear that the points at issue were so clear to him that he did not appreciate the necessity for precision in their expression. His use of words was sometimes unfortunate and inconsistent, so that the volume contains many apparent contradictions which detract from its value as a work of reference, and may lead to confusion. For instance, no less than 170 pages of the book are concerned with observations by means of the famous Aitken's Dust Counter, with page upon page of tables embodying the results of hundreds of skilful observations purporting to give the number of dust particles in the atmosphere (*pp.* 400-455, etc.), yet this instrument does not count dust particles but nuclei of water condensation in the air, and indeed dust in the sense usually understood has no effect upon the instrument. In an early communication dealing with what was later to be the essential principle of the dust counter Aitken said " . . . . " when speaking of the dust produced by combustion, I do not " mean the dust usually spoken of in connection with fires, as it " is comparatively heavy, and soon settles to the ground, nor do " I refer to smoke or soot. The dust I refer to is the invisible " dust, so fine that it scarcely settles out of the air. If we put " air into the experimental receiver and leave it for days . . . " we still find it fog-producing . . . ." (*p.* 49). Aitken must then have been aware of what his apparatus was capable of counting, yet at the head of the first paper describing the instrument appears the quotation " The gay motes that people the sunbeams " (*p.* 187), and, in the absence of further definition, again and again is the impression conveyed that what is referred to is dust in the ordinary sense of the word. It is nevertheless realised by Aitken that " particles " could be " produced by the splashing of water " (*p.* 204) and that " fine spray . . . . supplied active centres of condensation."

Had the first unusual definition of dust been adhered to throughout a great deal of confusion would have been avoided. But, in another paper on the " formation of small clear spaces in dusty air," the word " dust " signifies something entirely different, something which could be seen floating in the air by examination in an intense beam of light. Actually, in this instance, artificial chemical fumes were generally used, which settled fairly rapidly by the action of gravity. The " clear spaces " referred to are called " dustless spaces " (*p.* 87, last line). Nevertheless one dark space " would contain the dust of the atmosphere, which, however, is black compared with the brilliancy of the surrounding fog " (*p.* 90). Later it is considered " better . . . . as usual, under the name of dust particles,

to include all the solid and liquid products of combustion, of whatever size or colour they may be " (*p.* 284). In a subsequent paper on the formation of figures by the deposition of dust, the word again signifies the larger light-reflecting particles. It may possibly be argued that what applies to the larger particles must be also applicable to all dust, however fine, the only difference being one of degree, but this is uncertain and is not suggested by Aitken. A single molecule of hygroscopic substance might conceivably act as a nucleus of condensation, but it would not settle by gravity.

Equally original is the definition of the term " size " as applied to nuclei of condensation. " When, then we use the word ' size ' " he says, " we mean their condensing power, which does not necessarily mean their relative dimensions, though probably not far from it " (*p.* 549). The latter phrase, as is pointed out, involves the assumption that the surface attraction for water is the same for all kinds of particles ; which is obviously not true.

Nevertheless, when interpreted in the light of subsequent knowledge, the results of the dust counter observations are of far reaching importance ; it was first demonstrated by these experiments that the number of condensation nuclei in the atmosphere, whatever their nature and dimensions, may be of the order of 300 to 400 per cubic centimetre in very clear mountain air, and up to 466,000 per cubic centimetre in the polluted air of a city.

Light is also thrown upon the varied sources of the nuclei of condensation—from the action of the sun's rays upon the wet foreshore to products of the combustion of gas—and upon the hazing effect due to water condensation on the nuclei, even in unsaturated air, which varies according to the relative humidity.

The word " smoke " appears to suffer in a similar manner. Glasgow " smoke " could without doubt travel the twenty miles to Falkirk " as the dust counter showed the air to be always " very impure when the wind blew from densely inhabited areas " (*p.* 285). Yet it is stated later (*p.* 536), after the description of experiments in which the dust counter was not used, that the " greater amount of the smoke " would fall out of the air in its slow passage over 15 miles. In the former case, small condensation nuclei due to combustion would be counted ; these, as already shown, do not settle rapidly, therefore, presumably, in the latter case larger sized particles were implied.

Naturally some of the earlier conclusions are modified and amended by later papers since the work was progressive ; this does not take away from the value of the original experiments and adds to the interest of the book. The experiments described

throughout are triumphs of skill and ingenuity, and lead to many striking conclusions, of which the following are examples :—

The flow of glaciers is not due to simple melting of the ice under pressure, followed by regelation, but rather to the special structure of glacier ice.

Water in a freezing lake is cooled below the temperature of maximum density through a vertical interchange due to action of the wind, although in the case of the open sea different conditions obtain, and a similar interchange does not take place. It is of note that the latter conclusion was formed as a result of experiments carried out in a small trough.

The blue colour of the Mediterranean Sea is not due to the scattering of light by finely divided suspended matter, but to selective absorption in the water itself; in other words the sea appears blue because it actually is blue.

"Dew drops" on blades of grass are not composed of dew, but are sap exuded from the grass itself, and although genuine dew condenses from the air it is actually derived in the first place from the ground.

As is mentioned in the preface, "Dr. Aitken wrote very much as he thought and spoke," and consequently for the purposes of reference the information is somewhat scattered and diluted, and it is dangerous to select facts from any passage without careful reference to the whole of the paper of which it is a part. This is well illustrated in the paper "The Sun as a Fog Producer," where, following the description of the results of experiments carried out in glass flasks, it is shown that the conditions are here not the same as those obtained in Nature, owing to the absorption of certain of the sun's rays in passing through the glass walls, and that the results were different when flasks of clear silica were employed as containing vessels.

Taken as a whole, the Collected Papers make a book of absorbing interest. They will repay study by all who are alive to the importance of the physical side of meteorology.

——— G. M. WATSON.

Discussions at the Meteorological Office

December 10th, 1923. *The Preparation and Significance of Free-air Pressure Maps for the central and eastern United States.* By C. LeRoy Meisinger. (Monthly Weather Review, Supplement No. 21, Washington, 1922). *Opener*—Mr. E. G. Bilham, B.Sc.

Part I. of the paper is devoted to a historical summary of the attempts made by various meteorologists, from Guyot to Bigelow, to prepare satisfactory tables for the reduction of barometer readings in the United States to mean sea level. The problem is complicated by the existence of the great plateau at an average height of 3,500 ft. covering most of the western States. It is not surprising to learn that no satisfactory method of overcoming the difficulties surrounding this problem has yet been devised. The author, consequently, puts forward as one

of his main reasons for preparing upper air pressure charts that their use may lead to an improvement in the barometry of the plateau region.

In Part II. a useful summary of previous work on the construction of upper air pressure charts is given, but none of the methods adopted by previous investigators are considered suitable for use in the United States. Part III. is devoted to the consideration of various factors observable at the surface, the variations of which might be expected to give a measure of the variations in the mean temperature of the air column up to one or two kilometres. The wind direction is finally selected for the purpose, the justification of the choice being that the free-air temperature in the States depends more on the origin of the air supply than on anything else. The remainder of the paper consists of a detailed description of the method of procedure, and a discussion of certain specimen charts representing the pressure distribution at 1 and 2 kilometres.

The method of procedure is briefly as follows. From the kite observations at seven stations tables were prepared showing for each of eight wind directions and for each month of the year the average difference between the surface temperature and the mean temperature up to 1 km. and 2 km. These values were then plotted on maps and the corresponding values, read off from the charts for each of 32 " reduction stations " selected as having good anemometer exposures and giving a good geographical distribution over the central and eastern United States, were tabulated. From the tables so prepared the temperature argument in the reduction of the surface pressure readings to a height of 1 km. or 2 km. on any given occasion could be obtained if the wind direction and surface temperature were known. The actual pressure reductions were carried out by a nomographic method due to H. G. Schwerdt and W. W. Loebe. *

The author asserts that the movements of depressions and the distribution of rainfall, &c., are more directly associated with the pressure features at 1 km. and 2 km. than with those at mean sea level, and some examples are given in support of this view.

THE subjects for discussion for the next two meetings will be:

January 21st, 1924. *The auroral spectrum and the upper strata of the atmosphere*, and *The constitution of the upper strata of the atmosphere*, by L. Vegard (Phil. Mag. XLVI., 1923). *Opener*—C. E. Britton, B.Sc.

February 4th, 1924. *A statistical study of surface and upper air conditions in cyclones and anti-cyclones passing over Davenport, Iowa*, by A. D. Udden (Monthly Weather Review, February, 1923). *Opener*—Capt. J. Durward, M.A.

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* *Met. Zs. Wien*, vol. xxxviii., May, 1921, pp. 139-142.

Royal Meteorological Society

THE monthly meeting of the society was held on Wednesday, December 19th, at 49, Cromwell Road, South Kensington, Dr. C. Chree, F.R.S., President, in the Chair.

The President announced that the Symons Medal had been awarded to Professor Okada, the head of the Japanese Meteorological Service, in recognition of his services to meteorology.

W. H. Pick, B.Sc. and S. P. Peters, B.Sc.—A note on the vertical visibility (estimated looking downwards) at Cranwell, Lincolnshire, during the period February, 1922, to June, 1923.

Ever since aviation became general it has been recognised that the visibility aloft was an element of great importance, but there has been difficulty in organizing regular observations. At the Royal Air Force College, at Cranwell, arrangements have been made during the last two years for the flying instructors to report visibility; an analysis of the observations has been prepared by the authors of this paper. The outstanding feature of the results is that visibility depends principally on wind direction. At Cranwell visibility is good when the wind blows off the North Sea and bad when the air is fouled by the smoke from the Midlands. Horizontal visibility near the ground is affected by mist and fog as well as by smoke haze, so that it is not very surprising that the correlation between visibility on the ground and aloft is slight. At the height, 2,000 ft., at which the Cranwell observations were made, visibility is adversely affected by strong wind, but it was mentioned by Captain Douglas in the discussion that in his experience as an observer for the artillery during the war, mostly at greater heights, the seeing was better when the air currents were vigorous, presumably because the air in its more rapid passage across the industrial areas had picked up less smoke. It is clear that the forecasting of visibility at aerodromes must depend on the careful study of local conditions, and especially of the bearing of the centres of atmospheric pollution. Aviators should be enthusiastic supporters of the Smoke Abatement Society.

Harold Jeffreys, M.A., D.Sc.—The cause of cyclones.

In this paper Dr. Jeffreys classifies the principal theories which have been put forward in explanation of cyclones. He points out that the distribution of temperature suffices to explain the existence of large areas of high or low pressure, such as are associated with the monsoons, and that local convection would account for the minor disturbances whose dimensions are of the same order as the "height of the homogeneous atmosphere." No adequate theory which would account for tropical storms or for the cyclones of higher latitudes has been established on a numerical basis.

The work of Ryd,* who claims to have laid the foundation of such a theory, was not mentioned in the paper but was referred to in the discussion. Sir Napier Shaw urged that theorising was premature until we had before us the results of a complete set of observations at all heights for some particular cyclone. The organisation of such observations is clearly the most pressing duty of the authorities responsible for upper air research.

A. W. Lee, M.Sc., A.Inst.P.—The relation of the circulation in the upper air to a circumpolar vortex.

In the absence of Mr. Lee, Sir Napier Shaw gave an account of this paper. The method adopted by the author is to estimate the strength of the wind at specified heights by studying the distribution of pressure. He finds that to a first approximation the average movement of the air north of the horse-latitudes is the same as that of so many concentric rigid shells. In July the shell 4 kilometers above ground rotates in the same sense as the globe, and 2·6 per cent. faster; the corresponding estimates for the shells at 6 kilometers and 8 kilometers are 3·0 per cent. and 4·3 per cent. The actual movements of the air are of course very complicated, but this simple standard of reference will prove of great aid to clear thinking about the circulation of the atmosphere.

Correspondence

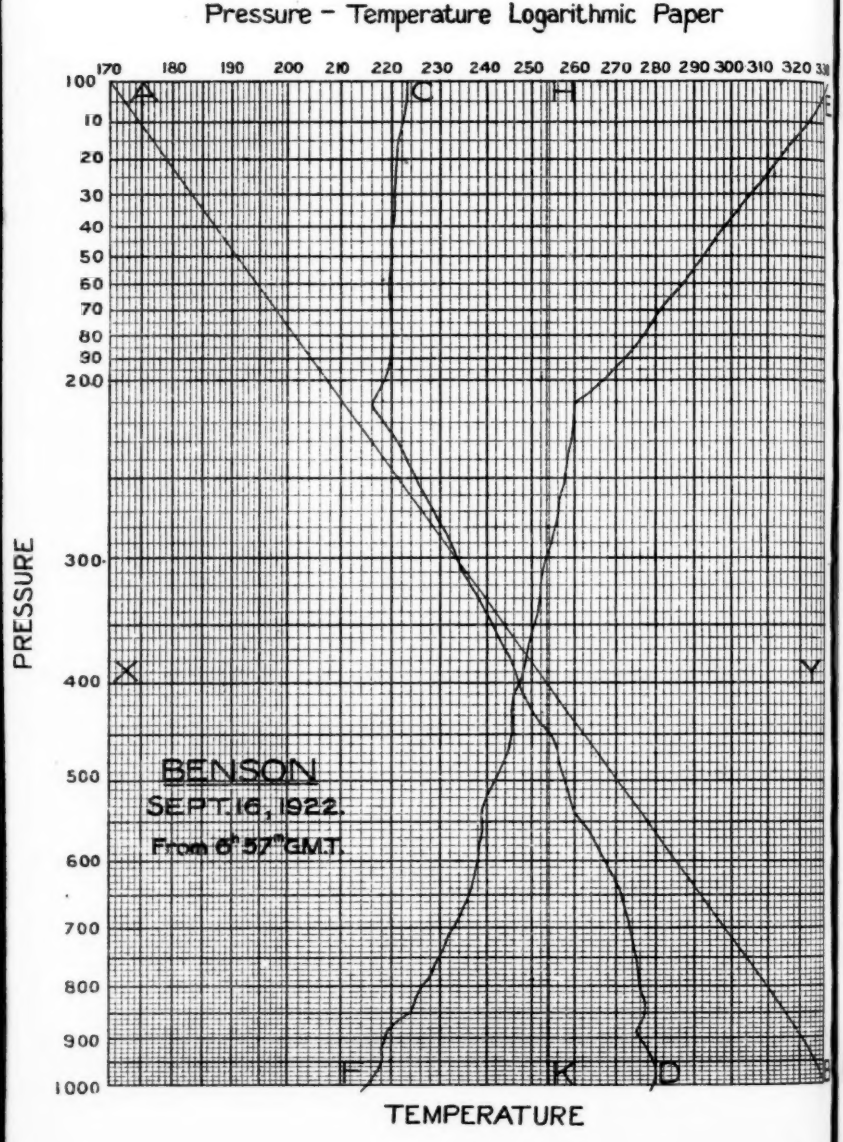
To the Editor, *The Meteorological Magazine*

Logarithmic Paper

YOUR readers may be interested to know that I have made arrangements for a supply of logarithmic paper, double-ruled, with different scales of ruling horizontally and vertically, for the special purpose of plotting the observed pressures and corresponding temperatures in the upper air.

The space occupied by the ruling goes comfortably into the quarto page of official publications so that diagrams reproduced full size would bind up conveniently. The logarithmic ruling one way is for pressure; it is on the common scale of logarithmic paper—that of the 10-inch or 25 cm. slide rule: within its 25 cm. it ranges from 1 to 10 and is the counterpart of 100 mb. to 1,000 mb. The ruling for temperature is at right angles on a scale two and a half times as great as that for pressure; enough of the range is ruled to plot temperatures from 170t to 330t

* Vide *Meteorological Magazine*, Vol. 58, Nov., 1923, p. 227.



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within 18 cm. The limits mentioned correspond with the limits of observation of atmospheric pressures and temperatures: hence the whole available range in either direction may be filled. With ordinary double-ruled logarithm paper the temperatures are all crowded within a narrow strip and two-thirds of the paper is necessarily unoccupied.

The great advantage of plotting pressures on the logarithmic paper is that, while the reality of pressure as a variable is preserved, the height can always be read on the vertical scale approximately, because equal intervals along it represent nearly equal steps of height. In the case of temperature the advantage is that the line of the dry adiabatics is straight so that potential temperatures can be read with the aid of a set square. There are other advantages of a more recondite character. The ranges of pressure and temperature shewn on the paper are such that the dry adiabatics, which give the potential temperature of any point by the reading of temperature at the point where they cut the base line, are lines parallel to one diagonal of the frame.

The paper is on sale by Messrs. W. F. Stanley & Co., Ltd., at 4s. 6d. per quire of 24 sheets.

There are doubtless many other applications of logarithmic paper, ruled differently in the two directions, and it is rather remarkable that the demand has not been anticipated.

NAPIER SHAW.

School of Meteorology, Imperial College of Science and Technology.

[To illustrate Sir Napier Shaw's letter a diagram drawn on the logarithmic paper has been reproduced half-size. The curve CD represents the relation between pressure and temperature as observed over Benson on September 16th, 1922. The curve EF is derived from CD, the horizontal intervals between the curve EF and the straight line HK being equal to those between the curve CD and the straight line AB. EF represents the relation between pressure and potential temperature, the potential temperature being defined for this purpose as the temperature obtained by adiabatic expansion or compression to the pressure 400 millibars.]

Minimum Thermometers

THE progressive increase of the correction of certain minimum thermometers which you describe in your December number has likewise been observed in France. I have recently talked the matter over with M. Tonnelot, a skilful maker of thermometers. According to him the phenomenon only takes place when methyl alcohol is employed. He recalls a variation amounting to some 5° C. in five years in some minimum thermometers which a

workman had inadvertently filled with methyl alcohol. An experimental test would be easy. If it confirmed M. Tonnelot's observation, it would have to be admitted that methyl alcohol was subject to contraction, doubtlessly by partial polymerisation at the ordinary temperature. It is moreover likely that in many thermometers ethyl alcohol is mixed with methyl alcohol, which is less expensive. This would explain the frequently observed small variations.

LOUIS BESSON.

Observatoire de Montsouris, Paris, December 27th, 1923.

NOTES AND QUERIES

Meteorology and Geography

Two meetings of interest to meteorologists took place at the Birkbeck College on January 3rd.

In the morning Sir Richard Gregory, the Editor of "Nature," gave his Presidential Address to the Geographical Association, his subject being "British Climate in Historic Times." The collection of the information on which the address was based must have involved much research and the examination of all kinds of literature. Sir Richard Gregory appears to have overlooked the work which is most frequently consulted in the Meteorological Office when questions are raised as to the weather of particular years—Lowe's "Chronology of the Seasons." There is scope, however, for more exhaustive examination of the subject, and it is to be hoped that the suggestion that this should be by co-operative effort will bear fruit. The general conclusion that our climate has not changed appreciably in the Christian era is not likely to be affected.

The afternoon meeting was devoted to the Conference on Meteorology in Education. Sir Napier Shaw presided. Mr. Dobson, who contributed the first paper, a valuable account of "Progress of Meteorology in the last Quarter of a Century," was kept away by illness, and the paper was read by Mr. Whipple. Mr. L. B. Cundall discussed some difficulties in the teaching of meteorology in schools, and Mr. W. G. W. Mitchell explained how wireless telegraphy gave opportunities for "Local Forecast Centres in Secondary Schools." The general discussion showed that there were wide differences of opinion as to the amount of meteorology which could find a place in school courses. A report of the Conference is to be published by Messrs. G. Philip & Sons, 32, Fleet Street, London, E.C. 4, from whom copies will be purchasable at 1s. 6d. each.

Wind and Weather

A LITTLE book, "Wind and Weather," by Professor Alexander McAdie, has been published by the Macmillan Company, of New York, as one of a series of "Outing Books." The book contains reproductions of the bas-reliefs in the library of the Blue Hill Observatory, allegorical figures of the winds copied from the Frieze of the Tower of the Winds at Athens.

Professor McAdie's comments are helpful. He points out the empty waterpot carried by Notos—the south wind—who has just discharged the rain, and the inverted fire basket from which Skiron—the north-west wind—"spills a generous stream of hot air on all below." To which last is added the jest: "his dusky Highness might not inappropriately adorn legislative halls and editorial sanctums." If the fire-basket is really a fire-basket (only an archæologist could say), we must suppose that the North-wester at Athens has often Foehn characteristics.

Professor McAdie quarrels with what he regards as the ordinary explanation of sea-breezes, and would substitute the following: "The sea-breeze is probably caused by a slow descent of dry, warm air, on an incline sloping from north-east to south-west. As it reaches the surface it . . . . . becomes an east wind. It carries inland with it some of the air over the ocean which is much cooler and heavily saturated." It seems hardly fair for the Professor of Meteorology at Harvard University to put such an unsupported and heretical theory before the unsuspecting general reader without more reservation than is implied by the word "probably."

Wind Suction in Lighthouses

EXPERIMENTS recently made at Inchkeith lighthouse have yielded results of interest in connection with the well-known effect discussed in an article in the July number of the *Meteorological Magazine* (p. 135). When observations were begun at Inchkeith the barometer was installed at the foot of the lighthouse tower, and it soon became evident that the barometer tended to read low, especially in strong winds. In attempting to find a better site a spare barometer was installed in a store near the tower, where it was hoped that the "lighthouse" effect would be negligible. As a result of observations made twice a day for three weeks, it was found that the lighthouse barometer registered a pressure lower on the average by about 0·4 mb. than that in the store, when both readings were corrected and reduced to mean sea level. The barometers were interchanged and a further set of readings taken, giving satisfactory confirmation. It was found moreover that the differences

increased progressively with the wind force, the average for winds of force 6 or above being 0·83 mb. in one series and 0·88 mb. in the other. Individual differences exceeded a millibar in several instances.

These observations serve to emphasise the importance of avoiding, as a site for a barometer, the base of a tower of any kind.

Observations at Stations of the First and Second Order, 1921

IN the recently issued Introduction to "Observations at Stations of the First and Second Order" for the year 1921, it is announced that the publication of observations in this form is being discontinued. The volume is accordingly the last of a series, which commenced with the year 1873. It is pointed out in the Introduction that the data which have been published in the 49 volumes provides adequate material for such researches as require daily readings at single stations. A list of the stations in the British Isles for which daily readings have been published in this or similar forms is given in the Introduction.

The Barometer at Sea

A PAPER on the effect of the rolling of a ship on the readings of a marine mercury barometer is contributed by Mr. M. A. Giblett to the October number of the *Philosophical Magazine*. Mr. Giblett made comparisons between the readings of a mercury barometer and an aneroid whilst on a trawler on the North Sea, and found that on the average there was a discrepancy of about half a millibar which was not explained by existing theories. The mercury barometer read lower than the aneroid. In the paper Mr. Giblett shows how the phenomenon may be explained. Owing to the rolling of the boat the point of support of the barometer oscillates from side to side, and the barometer swings in sympathy instead of remaining vertical. Imagine a simple pendulum of such a length that it will swing in time with the ship. The point of support of this imaginary pendulum is over the point of support of the actual barometer; the bob of the imaginary pendulum is an imaginary barometer, the axis of which is in line with the string of the pendulum. To a close approximation the actual barometer on the ship will move in the same way as this imaginary barometer. There is a difference in the vertical movement, but it turns out that this affects the "pumping" only, not the mean position of the mercury. On account of the oscillation the mercury is driven down by centrifugal force, and, on the other hand, on account of tipping, the mercury tends to rise. As it happens, the former effect is twice

as great as the latter, and therefore a depression of the mercury is to be expected. The amount of this depression is $\frac{1}{4}\ \frac{b}{L^2}\ h$, $2b$ being the distance through which the point of support of the barometer moves horizontally, L the length of the imaginary pendulum and h the barometric height. With oscillations of 4 feet, to and fro, and a period of 6 seconds, the length of the pendulum is 30 feet and the depression is a millibar: as Mr. Giblett found half a millibar as the average for occasions with and without appreciable rolling of the ship, there is satisfactory agreement with the observations. The moral is that to get the best readings of a barometer at sea it must be mounted below deck as near as possible to the axis of rolling of the ship. In this position the swing of the barometer will be reduced to a minimum.

Observations in Esthonia

THE first volume of a new series of year books, incorporating the meteorological observations made in Esthonia, has been issued. This volume includes the observations for 1921 at the Observatory of the University of Dorpat, as well as at the stations of the second and third order. It represents the 56th volume of the observatory reports and the 3rd of the reports for the second and the third order stations; data for earlier years are to be found for the latter stations in publications of the Russian Meteorological Service. The notes in the new publication are given in Esthonian, together with a German translation.

Computed Heights of Pilot Balloons

IT is generally recognised that the best way of determining the movements of a pilot balloon is by the use of two theodolites. The advantage of the method is that there are four instrumental readings to determine the position of the balloon, two readings for each theodolite. These readings act as a check on each other. The height of the balloon can be computed in two different ways, and if the two results are in agreement there is a guarantee that no errors have been made in observation or computation. We have received, however, a memorandum from Mr. C. E. Britton, in which he points out that this guarantee is not always valid: in fact it fails entirely when the balloon, as seen from one of the stations, lies near to the place at right angles to the line joining the two stations. In that case an error made in reading the azimuth at the former station cannot be detected by the comparison of computed heights.

Mr. Britton writes: "To take a concrete and very possible case, let the base line AB be 4,000 feet and the azimuths at A and B, 83° and 87° respectively. Let the elevations of the balloon at the two stations be 25° and 25°8′. The heights computed from these figures will agree exactly. If, however, the observer at A inadvertently records an azimuth of 84°, the difference* between the computed heights will only be 20 feet, a quantity well within the errors of experiment. There will, of course, be an error in the actual height of the balloon as deduced from these figures, and the existence of vertical currents in the atmosphere would be suggested erroneously. It follows that, in a double theodolite ascent, any pair of heights which, although agreeing in themselves, seem to be at variance with those they precede and follow, should be regarded with caution. Evidence of a bad observation should be sought for by examining the series of parallaxes or by differencing the azimuth observations before the abnormal result is accepted as indicative of a true vertical current in the atmosphere.

The Rainfall of 1923

THE months of greatest and least rainfall during the year were February and June. For the British Isles as a whole the rainfall of February amounted to about twice the average; it was the wettest February for at least twenty years. In June, on the other hand, the fall was about half the average for this month. March and June were the only months with a considerable deficiency over the British Isles generally. In the months of January, July, November and December the fall closely approximated to the average, but the fall was considerably above the average in April, May, August, September and October.

The main features of interest of the year as a whole were (1) that nearly everywhere over the British Isles the rainfall was above the average (the deficiency nowhere exceeding 10 per cent.), and (2) that generally the largest excesses occurred to the west. It is unusual for either of these features to be so highly developed in the rainfall of a year.

In England and Wales only isolated areas received less than the average, the largest being along the north-east coast from Middlesbrough to Berwick, others occurred in the neighbourhood of Sidmouth, Southampton, Bishop Stortford, Peterborough and Margate. Falls of more than 20 per cent. in excess were

*The correct height is 10,720 feet, the two computed heights are 11,910 and 11,930 feet. In another example worked out by Mr. Britton for the same base line, the azimuths at A and B are 89°30′ and 80°30′ the elevations 25° and 24°42′ and the observer at A inadvertently records an azimuth at 90°30′. The computed heights agree exactly, though they are in error by 170 feet. Correct height 10,590 feet. Computed heights 11,760 feet, 11,760 feet.]

confined mainly to the Devon-Cornwall peninsula, the north-western half of Wales and to the north-west of England. In these last two areas falls of as much as 40 per cent. in excess occurred. At Bryntirion, near Dolgelly, in Merionethshire, the fall amounted to 90·13 inches or 153 per cent. of the average. This being the largest amount registered in the locality, at any rate since 1868.

In Scotland less than the average was recorded only in the south-east corner. Falls exceeding 20 per cent. above the average were widespread, occupying the greater part of the western half of Scotland and also the counties of Aberdeen, Banff and Kincardine. At Eallabus in Islay the fall amounted to 75·82 in., or 155 per cent. of the average, and was the largest total since the record began in 1866.

In Ireland areas with deficient rainfall were confined to a coastal strip in the south and to an isolated area in the neighbourhood of Cavan. Falls of more than 20 per cent. in excess occurred in an area to the north-west stretching from the Connemara Mountains to Londonderry, and in this area there were excesses of as much as 30 per cent., an unusual occurrence there.

At London, Camden Square, the annual total was 27·03 in., or 110 per cent. of the average. At Edinburgh, Royal Observatory, 24·21 in., or 99 per cent., and at Dublin, Fitz-William Square, 28·49 in., or 104 per cent.

The general rainfall of the countries has been provisionally computed :—

England and Wales	113	per cent. of the average 1881-1915.
Scotland	118	
Ireland	110	
British Isles	113	

Atmospheric Pollution

THE Secretary of the Atmospheric Pollution Committee reports that deposit gauges have recently been brought into use by local authorities at the following places : Stoke-on-Trent, Blackburn, Rochdale, Salford and Huddersfield, as well as by Messrs. Cadbury, at Bournville, near Birmingham. The new gauges at Blackburn and Rochdale are in addition to older ones. Observations with an automatic filter have been started at Stoke-on-Trent.

According to the *Chicago Tribune* a terrific blizzard was raging over the northern part of the United States on January 6th. Several people have been frozen to death, and the transportation of foodstuffs is held up in several States. Temperature in Chicago is said to be the lowest recorded since 1904.

Obituary

Flight-Lieutenant A. E. Gendle.—Flight-Lieut. Gendle, whose tragic death in Mesopotamia was reported in the last number of the *Meteorological Magazine*, was, before the War, on the staff of the Meteorological Office. He had been at Kew Observatory as a boy, and was one of the two assistants sent from Kew Observatory to Eskdalemuir, when that observatory was opened in 1908. After serving five years there he was transferred to South Kensington. On the outbreak of war he was mobilised as a trooper in the Middlesex Yeomanry. This regiment was quartered in the neighbourhood of London up to the middle of 1915, when Gendle tiring of inaction made an effort to join the Naval Air Force. It happened that he got into touch with the Officer responsible for the Naval Meteorological Service and was offered a commission as a meteorologist. At this time the use of small airships for patrolling home waters necessitated the establishment of meteorological stations at coast aerodromes. The first of these was established at Capel, near Folkestone, under Gendle's supervision. He was later at the Admiralty, and was transferred to the Royal Air Force on the formation of that branch as a separate unit. He took a prominent part in its Meteorological Service, which, while working in close co-operation with the Meteorological Office, became responsible for the issue of forecasts and reports to airships and aeroplanes operating in and around the British Isles. At the end of the War, Gendle accepted a permanent commission in the R.A.F. He was sent to 'Iraq on meteorological duty, and at the time of his death was in charge of the arrangements for the supply of information to pilots on the overland air-route from Egypt to Palestine and Bagdad.

M. Alexandre Gustave Eiffel.—The death has occurred in Paris of M. Gustave Eiffel, designer of the tower which bears his name. M. Eiffel was born at Dijon, in 1832, and was educated as an engineer. His earlier work was concerned mainly with bridge building, so that he was well equipped for his great enterprise, the design and erection of the Eiffel Tower. For the construction of the tower, which was completed in 1889, meteorologists are doubly indebted to him. In 1900 he took up meteorological research, and for some years published an annual "Atlas Météorologique." From 1907 onwards his chief study was aero-dynamics.

M. R. P. Marc Dechevrens, S.J.—M. Marc Dechevrons, whose death occurred on December 6th, 1923, had been Director of the St. Louis Observatory, Jersey, since 1894. Before this he was Director of the Zi-Ka-Wei Observatory (China), between 1875

and 1887, and it was during this period that he published his main meteorological work which dealt with the typhoons of the China Sea. He also devoted much energy to the study of atmospheric electricity and of the Zodiacal light.

News in Brief

We regret to announce the death of *Dr. Fusakichi Omori*, Professor of Seismology, and President of the Imperial Earthquake Investigation Committee, which took place at Tokio on November 8th, 1923.

By invitation of His Majesty the King of Egypt, an International Geographical Congress will meet at Cairo in 1925, this being the 50th anniversary of the foundation of the Royal Geographical Society of Egypt. Meteorology is to be included in the programme.

On the programme of the Annual Meeting of the American Meteorological Society, held in conjunction with the American Association for the Advancement of Science on December 29th, was a proposal for a World Meteorological Foundation.

The gold medal of the Royal Scottish Geographical Society has been awarded to Dr. Hugh Robert Mill in recognition of his distinguished service in geographical research.

A good example of a Lunar Cross was observed by Miss Penny at Delnies, Nairn, on October 25th. As the moon rose a beam exactly like that from a searchlight was seen on the sky, and when the moon was a little higher " it appeared to have a clear ray of light perpendicularly through it and a slight ray across."

The Weather of December, 1923

THE weather conditions during the beginning of December were somewhat less severe than those which were so prevalent in November, but " snow lying " was still reported from many parts of the country, and the mean temperature for the first week was below the normal except in the extreme north. Screen minima as low as 15° F. and 22° F. were recorded at Balmoral on the morning of the 4th, and at Durham on the 5th respectively.

Mist and fog were also general during this time. After the 9th, on which day maxima under 40° F. were experienced, the British Isles came under the influence of a more southerly current of air from the Atlantic, and temperature rose to 50° F. generally, and to 55° F. at a few stations in Scotland, e.g., Onich (Inverness) and Ford (Argyle). In the north and west this milder weather was accompanied by much rain, though the readings for any one day were not so large as those recorded at a few places on the 1st and 2nd when 62 mm. fell at Llyn Fawr (Glamorganshire), and 57 mm. at Treherbert (Glamorganshire) on the 1st, and 55mm. at Trecastle (Breconshire) on the 2nd.

Between the 19th and the 22nd, cold northerly winds swept the country and snow fell generally. From then onwards to the end of the month there were alternating milder and cold periods in the easterly parts of the kingdom. Snow occurred in the London area on the 19th, 21st and 26th. In the west the conditions were somewhat milder, though during the last ten days of the month severe ground frosts were recorded in all parts of the country, the readings of the thermometer exposed on the snow falling below 10° F. at a few places. The lowest screen minima for the month were also recorded at many stations during this period, the actual lowest reading being 13° F. at Eskdalemuir on the 25th, and at Renfrew on the 29th. High southerly winds and gales were experienced on the coasts about the 2nd and 7th, and the westerly and northerly winds were frequently rough during the latter part of the month.

The record of the month in Europe has been one of rain and snow. In Italy the heavy rain, which in conjunction with a thaw caused the bursting of the great dam of Lake Gleno on the 1st, continued for another week, and the Tiber, Arno and other rivers were all in flood. On the 23rd it was reported that a heavy gale was blowing down the Adriatic, and very low temperatures were recorded over the whole of Italy, with snow in the south ; a heavy fall of snow occurred in Rome in the night of the 30th. Snow is rare in southern Italy. In Austria there were heavy snowfalls from the 21st to the 27th, and railway traffic was interrupted. Switzerland has suffered an alternation of thaw and frost—very mild until the 20th, followed by two days of heavy snow and low temperatures, some of which are stated to be " records " for the time of year. On the 23rd there was a decided thaw, followed by frost and very heavy snow from the 24th to the 26th. On the latter date a gale set in, followed by a thaw and heavy rain up to 3,000 feet. In many mountain valleys ten feet of snow fell between the 23rd and the 27th. On the 28th, with a westerly gale, the rain and thaw extended to a height of 4,800 feet, and it was not until the 31st

that the normal fine cold weather of winter was established. Under these conditions avalanches have been exceptionally frequent, causing some loss of life, much damage to buildings and interruption of train services.

Over N.E. France the month was very wet, as were the first two days of January, 1924. The following rainfall figures represent something short of the total amounts for the periods indicated :—

Period	Paris	Romilly	Nancy	Belfort	Dijon
	mm.	mm.	mm.	mm.	mm.
Dec. 1-31 ..	114	119	67	74	87
Dec. 22-31 ..	60	76	52	41	57
Jan. 1-2 ..	14	15	7	28	17

The normal rainfall at Paris during the whole winter is about 100 mm. It is not surprising that floods occurred, for the two previous months were also wet. From the 25th to the 31st the Seine rose steadily. At the end of the month it was 18½ feet above its normal level at Paris, and a further rise was feared, so that the disaster of 1910 may be repeated. Towards the end of the month the Rhine also began to rise, and parts of Cologne were flooded. In Denmark Christmas was stormy and snowy.

In eastern Australia drought was experienced until the 26th, when good general rains fell in northern and western New South Wales, and more scattered rain in central and western Queensland. A violent hailstorm swept over Pretoria on the 25th, and it is stated that many of the hailstones weighed more than 16 ounces. Much damage was done.

The special message from Brazil states that the rainfall was much below the normal in all districts, and principally in the centre, where the deficit amounted on the average to 100 mm. Temperature was generally one or two degrees above the normal, and the cane and sugar crops have suffered from the hot dry weather. At Rio de Janeiro pressure was 2·5 mm. and temperature 2° C. above the normal.

Mr. R. C. Mossman writes that a cold wave was experienced in the Argentine on the 7th and 8th, associated with a rise of pressure of 28 mb. in two days at Cordoba. The shade minima fell to 28° F. at Chubut on the 7th, and 39° F. at Cordoba on the 8th, these being 20° to 25° F. below the normal for the time of year.

Rainfall December, 1923: General Distribution

England and Wales	102	per cent. of the average 1881-1915.
Scotland	101	
Ireland	89	
British Isles	99	

Rainfall Table for December, 1923

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square.....	2·31	59	97	*War*	Birmingham, Edgbaston	3·11	79	116
Sur .	Reigate, Hartswood...	2·82	72	...	*Leics*	Leicester Town Hall...	2·66	68	...
Kent.	Tenterden, View Tower	2·84	72	91	,, .	Belvoir Castle.....	2·71	69	110
,, .	Folkestone, Boro. San.	2·76	70	...	*Rut* .	Ridlington.....	2·48	63	...
,, .	Broadstairs	2·17	55	91	*Linc.*	Boston, Skirbeck	3·03	77	141
,, .	Sevenoaks, Speldhurst.	3·11	79	...	,, .	Lincoln, Sessions House	2·44	62	111
Sus .	Patching Farm.....	3·38	86	101	,, .	Skegness, Estate Office.	2·74	70	125
,, .	Eastbourne, Wilm. Sq.	3·71	94	106	,, .	Louth, Westgate	2·70	69	97
,, .	Tottingworth Park....	4·20	107	88	,, .	Brigg	2·76	70	113
Hants	Totland Bay, Aston...	2·82	71	87	*Notts.*	Worksop, Hodsock....	2·59	66	110
,, .	Fordingbridge, Oaklnds	4·32	110	109	*Derby*	Mickleover, Clyde Ho..	3·51	89	133
,, .	Portsmouth, Vic. Park.	3·18	81	102	,, .	Buxton, Devon. Hos...	6·13	156	108
,, .	Ovington Rectory	3·96	101	100	*Ches* .	Runcorn, Weston Pt...	4·49	114	142
,, .	Grayshott	3·54	90	93	,, ..	Nantwich, Dorfold Hall	4·51	115	...
Berks	Wellington College...	2·69	68	93	*Lancs*	Bolton, Queen's Park .	6·08	154	,,.
,, .	Newbury, Greenham..	3·44	87	108	,, ..	Stonyhurst College....	5·05	128	104
Herts.	Bennington House....	2·51	64	101	,, ..	Southport, Hesketh...	4·89	124	151
Bucks	High Wycombe	3·62	92	124	,, ..	Lancaster, Strathspey.	4·66	118	...
Oxf. .	Oxford, Mag. College..	2·34	59	101	*Yorks*	Sedbergh, Akay	6·59	167	112
Nor .	Pitsford, Sedgebrook..	2·91	74	120	,, .	Wath-upon-Dearne ...	2·35	60	99
,, .	Eye, Northolm.....	2·15	55	...	,, .	Bradford, Lister Pk...	3·43	87	103
Beds.	Woburn, Crawley Mill.	2·36	60	100	,, .	Oughtershaw Hall	5·44	138	...
Cam.	Cambridge, Bot. Gdns.	1·94	49	101	,, .	Wetherby, Ribston H..	3·43	87	140
Essex	Chelmsford, CountyLab	1·96	50	...	*ERY*	Hull, Pearson Park ...	3·10	79	129
,, .	Lexden, Hill House...	2·27	58	...	,, .	Holme-on-Spalding ...	3·15	80	...
Suff .	Hawkedon Rectory ...	2·73	69	113	,, .	Lowthorpe, The Elms.	3·22	82	120
,, .	Haughley House.....	2·50	63	...	*NRY*	West Witton, Ivy Ho..	2·86	73	...
Norf.	Beccles, Geldeston....	2·87	73	125	,, .	Pickering, Hungate ...	3·52	89	...
,, .	Norwich, Eaton	3·11	79	119	,, .	Middlesbrough	2·11	54	109
,, .	Blakeney	2·86	73	129	,, .	Baldersdale, Hury Res.	2·53	64	62
,, .	Swaffham	3·77	96	158	*Durh.*	Ushaw College	1·87	48	75
Wilts.	Devizes, Highclere....	3·67	93	...	*Nor* .	Newcastle, Town Moor.	2·34	59	97
Dor .	Evershot, Melbury Ho.	3·67	93	71	,, .	Bellingham Manor....	2·50	63	...
,, .	Weymouth, Westham..	3·53	90	101	,, .	Lilburn Tower Gdns...	3·71	94	...
,, .	Shaftesbury, Abbey Ho.	2·90	73	80	*Cumb*	Penrith, Newton Rigg..	3·53	90	82
Devon	Plymouth, The Hoe...	3·54	90	71	,, .	Carlisle, Scaleby Hall .	2·95	75	92
,, .	Polapit Tamar	5·84	148	114	,, .	Seathwaite	10·20	259	62
,, .	Ashburton, Druid Ho..	5·59	142	74	*Glam.*	Cardiff, Ely P. Stn....	4·16	106	81
,, .	Cullompton	3·68	94	84	,, .	Treherbert, Tynywaun	10·47	266	...
,, .	Sidmouth, Sidmount ..	3·29	84	84	*Carm*	Carmarthen Friary....	5·33	135	93
,, .	Filleigh, Castle Hill ...	6·41	163	...	,, .	Llanwrda, Dolaucothy.	7·12	181	102
,, .	Hartland Abbey.....	4·64	118	...	*Pemb*	Haverfordwest, Portf'd	5·31	135	93
Corn.	Redruth, Trewirgie ...	5·07	129	81	*Card.*	Gogerddan.....	4·62	117	92
,, .	Penzance, Morrab Gdn.	4·59	117	81	,, .	Cardigan, County Sch. .	3 59	91	...
,, .	St. Austell, Trevarna..	5·63	143	92	*Brec* .	Crickhowell, Talymaes	3·50	89	...
Soms	Chewton Mendip	4·82	122	90	*Rad* .	Birm.W.W.Tyrmynydd	6·39	162	78
,, .	Street, Hind Hayes ...	2·71	69	...	*Mont.*	Lake Vyrnwy	5·71	145	83
Glos. .	Clifton College	3·13	79	82	*Denb.*	Llangynhafal	4·50	114	...
,, .	Cirencester	3·73	95	108	*Mer* .	Dolgelly, Bryntirion..	8·18	208	119
Here.	Ross, County Obsy.	1·99	51	67	*Carn.*	Llandudno	3·18	81	103
,, .	Ledbury, Underdown.	1·98	50	71	,, .	Snowdon, L. Llydaw 9	20·73	527	...
Salop	Church Stretton.....	3·42	87	102	*Ang* .	Holyhead, Salt Island.	3·32	84	80
,, .	Shifnal, Hatton Grange	2·86	73	111	,, .	Lligwy	3·26	83	...
Staff.	Tean, The Heath Ho...	4·92	125	151	*Man.*	Douglas, Boro' Cem...	5·78	147	115
Worc.	Ombersley, Holt Lock.	2·48	63	95	*Guer.*	St. Peter Port, Grange.	3·67	93	90
,, .	Blockley, Upton Wold.	3·50	89	108	*Wigt.*	Stoneykirk, Ardwell Ho	8·00	203	195
War	Farnborough.....	3·32	84	113	,, .	Pt. William, Monreith .	6·41	163	...

Errata November—Beccles, Geldeston, should read | 2·68 | 68
Lligwy ... ... ,, ,, | 6·92 | 176

Rainfall Table for December, 1923—*continued*

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm	Per-cent. of Av.
Kirk.	Carsphairn, Shiel.	10·66	271	...	*Caith*	Loch More, Achfary ...	12·09	307	131
„ .	Dumfries, Cargen	4·42	112	82	„ ..	Wick	4·35	110	141
Dum	Drumlanrig	4·53	115	86	*Ork .*	Pomona, Deerness	4·35	110	104
Roxb	Branxholme	2·44	62	67	*Shet .*	Lerwick	5·22	133	109
Selk .	Ettrick Manse	4·92	125	...	*Cork.*	Caheragh Rectory	4·90	125	...
Berk.	Marchmont House	3·13	79	111	„ ..	Dunmanway Rectory.	4·42	112	55
Hadd	North Berwick Res....	2·36	68	124	„ ..	Ballinacurra	1·96	50	38
Midl	Edinburgh, Roy. Obs..	2·35	60	109	„ ..	Glanmire, Lota Lo. ...	2·79	71	51
Lan .	Biggar	2·84	72	84	*Kerry*	Valencia Obsy.	5·35	136	81
Ayr .	Kilmarnock, Agric. C..	4·68	119	110	„ .	Gearahameen	12·00	305	...
„ .	Girvan, Pinmore	7·31	186	122	„ .	Killarney Asylum	4·62	117	63
Renf.	Glasgow, Queen's Pk..	2·87	73	68	„ .	Darrynane Abbey	3·11	79	53
„ .	Greenock, Prospect H..	5·81	148	74	*Wat .*	Waterford, Brook Lo..	2·71	69	58
Bute.	Rothesay, Ardencraig.	6·47	164	119	*Tip .*	Nenagh, Cas. Lough...	4·15	105	90
„ .	Dougarie Lodge	6·75	171	...	„ .	Tipperary	3·20	81	...
Arg .	Glen Etive	7·41	188	...	„ .	Cashel, Ballinamona ..	3·43	87	79
„ .	Oban	6·41	163	...	*Lim .*	Foynes, Coolnanes	4·71	120	100
„ .	Poltalloch	7·12	181	112	„ .	Castleconnell Rec.	5·34	136	...
„ .	Inveraray Castle.....	8·14	207	82	*Clare*	Inagh, Mount Callan ..	8·28	210	...
„ .	Islay, Eallabus.....	8·56	217	144	„ .	Broadford, Hurdlest'n.	5·07	129	...
„ .	Mull, Benmore	21·40	544	...	*Wexf*	Newtownbarry	2·91	74	...
„ .	Mull, Quinish	...	..	...	„ .	Gorey, Courtown Ho...	2·90	74	76
Kinr.	Loch Leven Sluice	2·72	69	69	*Kilk.*	Kilkenny Castle	2·60	66	75
Perth	Loch Dhu	6·10	155	61	*Wic .*	Rathnew, Clonmannon	2·27	58	...
„ ..	Balquhidder, Stronvar.	3·67	93	38	*Cars.*	Hacketstown Rectory .	2·98	76	73
„ ..	Crieff, Strathearn Hyd.	2·94	75	66	*QCo..*	Blandsfort House.....	...	...	...
„ ..	Blair Castle Gardens ..	2·56	65	...	„	Mountmellick	4·13	105	...
„ .	Coupar Angus School..	2·79	71	93	*KCo.*	Birr Castle	3·19	81	97
Forf.	Dundee, E. Necropolis.	2·85	72	107	„ .	Ballycumber, Bellair..	...	...	...
„ .	Pearsie House.....	4·16	106	...	*Dubl.*	Dublin, FitzWm. Sq...	1·54	39	62
„ .	Montrose, Sunnyside..	3·39	86	122	„ .	Balbriggan, Ardgillan .	2·76	70	96
Aber.	Braemar Bank	3·47	88	97	*Me'th*	Drogheda, Mornington	2·48	63	...
„ .	Logie Coldstone Sch. ..	3·17	81	113	*W.M*	Mullingar, Belvedere .	3·29	84	89
„ .	Aberdeen, Cranford Ho	4·93	125	142	*Long*	Castle Forbes Gdns....	2·89	73	73
„ .	Fyvie Castle	4·45	113	...	*Gal .*	Galway, Waterdale	3·76	95	...
Mor .	Gordon Castle.....	3·25	83	121	*Mayo*	Crossmolina, Enniscoe	4·99	127	76
„ .	Grantown-on-Spey....	3·57	91	132	„ .	Mallaranny.....	7·94	202	...
Na .	Nairn, Delnies.....	2·07	53	93	„ .	Westport House.....	4·42	112	77
Inv..	Ben Alder Lodge	5·38	137	...	„ .	Delphi Lodge	13·20	335	...
„ .	Kingussie, The Birches	2·53	64	...	*Sligo*	Markree Obsy.	4·79	122	100
„ .	Fort Augustus	3·02	77	52	*Ferm*	Enniskillen, Portora ..	4·28	109	...
„ .	Loch Quoich, Loan....	11·30	287	...	*Arm.*	Armagh Obsy.	2·94	75	94
„ .	Glenquoich	11·07	281	76	*Down*	Warrenpoint	3·20	81	...
„ .	Inverness, Culduthel R.	1·90	48	...	„ .	Seaforde	4·84	123	117
„ .	Arisaig, Faire-na-Squir	7·21	183	...	„ .	Donaghadee	4·37	111	138
„ .	Fort William.....	6·86	174	68	„ .	Banbridge, Milltown .	2·83	72	98
„ .	Skye, Dunvegan.....	8·46	215	...	*Antr.*	Belfast, Cavehill Rd. ..	5·20	132	...
„ .	Barra, Castlebay	3·83	97	...	„ .	Glenarm Castle.....	5·53	141	...
R&C	Alness, Ardross Cas. ..	3·54	90	86	„ .	Ballymena, Harryville	6·04	153	136
„ .	Ullapool.....	5·96	151	...	*Lon .*	Londonderry, Creggan	5·50	140	126
„ .	Torridon, Bendamph..	11·43	290	112	*Tyr .*	Donaghmore	4·41	112	...
„ .	L. Carron, Plockton...	5·82	173	...	„ .	Omagh, Edenfel	4·56	116	108
„ .	Stornoway	5·79	147	93	*Don .*	Malin Head	4·76	121	142
Suth.	Dunrobin Castle.....	...	...	...	„ .	Letterkenny Hospital .	4·99	127	93
„ .	Lairg	3·90	99	...	„ .	Dunfanaghy	4·78	121	92
„ .	Tongue Manse.....	4·92	125	99	„ .	Narin, Kiltoorish	5·75	146	...
„ .	Melvich School.....	4·83	123	112	„ .	Killybegs, Rockmount.	9·12	232	125

Climatological Table for the British Empire, July, 1923

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1016·2	+ 0·4	90	49	75·7	57·7	66·7	+ 4·0	60·5	69	5·8	83	+ 28	11	7·5	47
Gibraltar	1016·7	+ 1·4	90	60	82·5	67·2	74·8	+ 0·1	67·2	69	1·9	0	— 1	0	...	...
Malta	1016·4	+ 2·4	99	63	84·7	72·5	78·6	+ 1·1	71·0	69	1·0	0	— 1	0	...	...
Sierra Leone	1014·1	+ 0·7	88	70	83·0	72·3	77·7	— 1·3	73·4	84	8·5	883	+ 7	30	...	...
Lagos, Nigeria	1013·5	— 0·3	85	71	81·1	73·4	77·2	— 0 1	74·4	84	9 1	265	— 4	22	...	...
Kaduna, Nigeria	1016·4	+ 2·4	86	62	81 9	65·8	73·9	— 0·7	69·1	85	1·6	187	— 45	22	...	...
Zomba, Nyasaland	1017·4	— 0·5	80	46	74·1	53·7	63·9	+ 2·2	...	87	2·5	11	+ 4	4	...	...
Salisbury, Rhodesia	1019·9	— 1·0	77	31	72·9	39·9	56·4	+ 0·3	50·0	64	1·4	0	— 1	0	...	...
Cape Town	1021·2	— 0·1	76	37	62·0	47·8	54·9	0·0	52·5	83	5·7	95	+ 5	16	...	...
Johannesburg	1023·5	— 2·1	65	29	58·6	40·0	49·3	— 1·3	38·7	59	3·0	26	+ 20	4	8·9	84
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Calcutta, Alipore Obsy.	998·1	— 1·1	94	77	88·6	78·8	83·7	+ 0·2	78·9	87	8·9	415	+ 88	17*	...	...
Bombay	1002·4	— 1·3	88	74	83·8	77·4	80·6	— 0·5	77·2	87	9·6	1099	+460	26*	...	...
Madras	1004·0	— 0·5	104	74	98·9	79·9	89·4	+ 2·1	74·9	58	8·1	42	— 62	4*	...	...
Colombo, Ceylon	1009·5	+ 1·4	86	72	84·7	75·7	80·2	— 1·1	76·9	77	9·1	316	+186	24	5·7	46
Hong Kong	1003·9	— 1·0	91	74	86·1	78·8	82·5	0·0	77·5	81	7·9	471	+152	18	6·5	49
Sandakan	...	...	90	74	87·6	74·8	81·2	— 0·7	76·4†	78†	...	269	+103	11	...	...
Sydney	1016·1	— 2·4	68	41	61·3	46·8	54·1	+ 1·7	48·7	68	4·7	207	+ 84	14	5·6	55
Melbourne	1016·2	— 2·9	65	37	55·2	44·4	49·8	+ 1·2	47·5	80	7·1	72	+ 26	18	2·6	27
Adelaide	1019·3	— 1·1	68	41	59·2	47·0	53·1	+ 1·5	49·4	76	7·7	127	+ 60	22	2·8	28
Perth, W. Australia	1020·6	+ 1·5	69	40	63·1	48·5	55·8	+ 0·7	51·4	73	5·9	116	— 50	18	4·6	45
Coolgardie	1021·9	+ 2·0	67	33	61·3	41·4	51·3	+ 0·1	48·1	61	4·1	18	— 5	9	...	...
Brisbane	1017·3	— 1·0	75	43	68·4	49·3	58·9	+ 0·6	53·6	61	3·1	52	— 4	6	8·2	78
Hobart, Tasmania	1012·0	— 1·8	63	35	54·0	41·7	47·9	+ 2·5	44·6	77	6·6	34	— 20	15	3·8	41
Wellington, N.Z.	1015·5	+ 2·6	59	35	51·9	42·7	47·3	— 0·2	44·3	79	7·7	96	— 48	19	3·1	33
Suva, Fiji	1012·6	— 1·6	85	63	78·3	67·8	73·1	— 0·5	70·2	88	6·1	186	+ 69	14	...	...
Kingston, Jamaica	1014·4	— 0·3	95	71	91·2	73·3	82·3	+ 0·6	...	64	4·5	12	— 30	2	...	...
Grenada, W.I.	1014·9	+ 1·6	86	72	84·0	74·2	79·1	+ 0·2	74·9	77	5·6	215	— 34	26	...	...
Toronto	1016·0	+ 1·9	92	51	78·8	59·1	68·9	+ 0·7	62·5	69	4·6	44	— 33	10	...	...
Winnipeg	1013·6	+ 0·9	96	45	83·2	59·7	71·5	+ 5·3	64·5	68	3·5	90	+ 13	15	...	...
St. John, N.B.	1014·8	+ 1·1	85	47	68·3	46·5	57·4	— 3·0	54·4	79	6·6	53	— 39	12	...	...
Victoria, B.C.	1016·1	— 0·6	82	48	67·4	52·3	59·9	— 0·4	54·9	78	3·6	24	+ 15	6	...	...

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen. † Mean of observations at 9h., 15h., 21h., from April, 1923.

Winnipeg	1013·6	+ 0·9	96	45	83·2	59·7	71·5	+ 5·3	64·5	68	3·5	90	+ 13	15	...	...
St. John, N.B.	1014·8	+ 1·1	85	47	68·3	46·5	57·4	— 3·0	54·4	79	6·6	53	— 39	12	...	...
Victoria, B.C.	1016·1	— 0·6	82	48	67·4	52·3	59·9	— 0·4	54·9	78	3·6	24	+ 15	6	...	...

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